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(71) Applicant
Delta Circuit Protection & Controls Ltd

(Incorporated in the United Kingdom)

Reddings Lane, Birmingham, B11 3EZ,
United Kingdom

(72) Inventor
John Stevens

(74) Agent and/or Address for Service
Marks & Clerk
Alpha Tower, Suffolk Street Queensway, Birmingham,
B1 1TT, United Kingdom

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(54) Electric circuit breaker

(57) An electric circuit breaker comprises a rotatably mounted cross-bar (19) and at least one pair of first and second contacts the or each first contact (20) being pivotally mounted on the cross-bar (19) for movement between an operating position and a blown-back position caused by electromagnetic forces generated when a high fault current occurs. An operating mechanism effects rotation of the cross-bar between a closed position in which the first and second contacts of the or each pair normally engage each other, and an open position in which the first and second contacts of the or each pair are separated from one another. In relation to the or each pair of contacts there is provided a compression spring (41) located in a recess in the cross-bar (19), and an elongate cam follower (42) guided in a pair of grooves (38, 39) formed in the cross-bar (19). The cam follower (42) is urged by the spring (41) into engagement with a cam surface (45, 46) formed on the first contact (20).

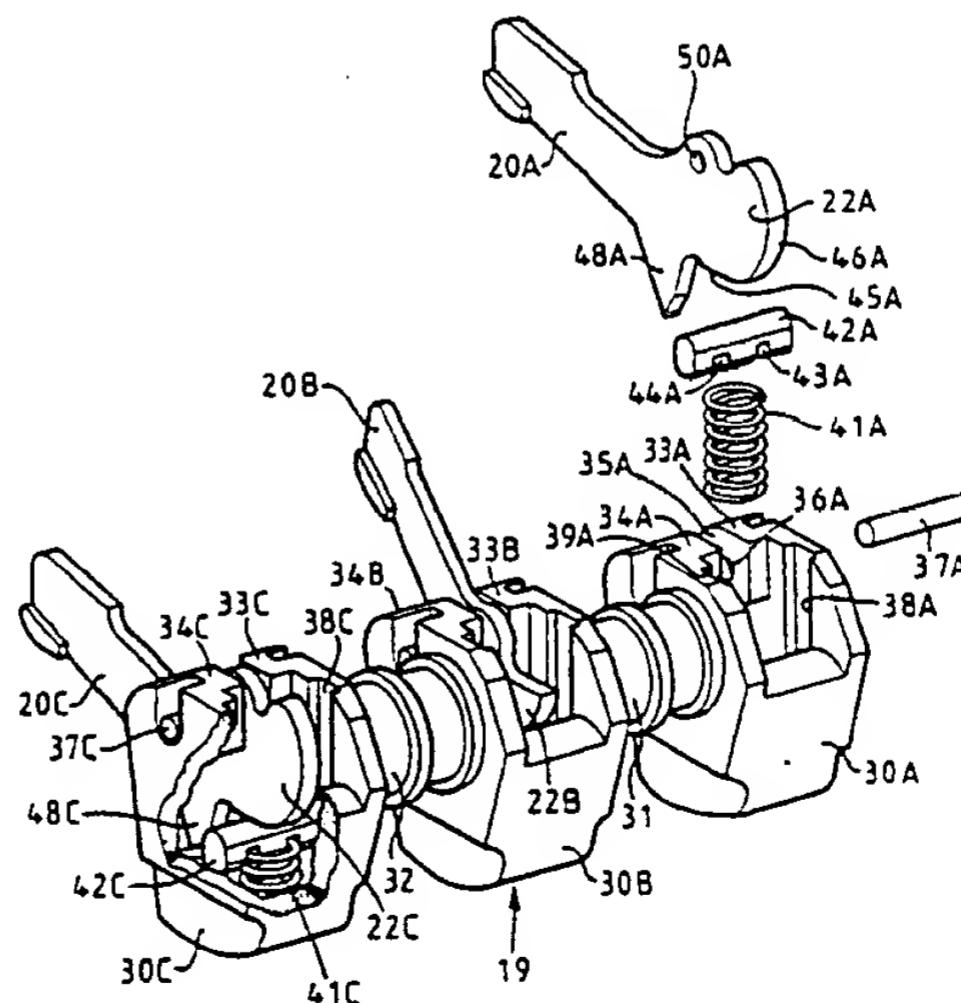


FIG 3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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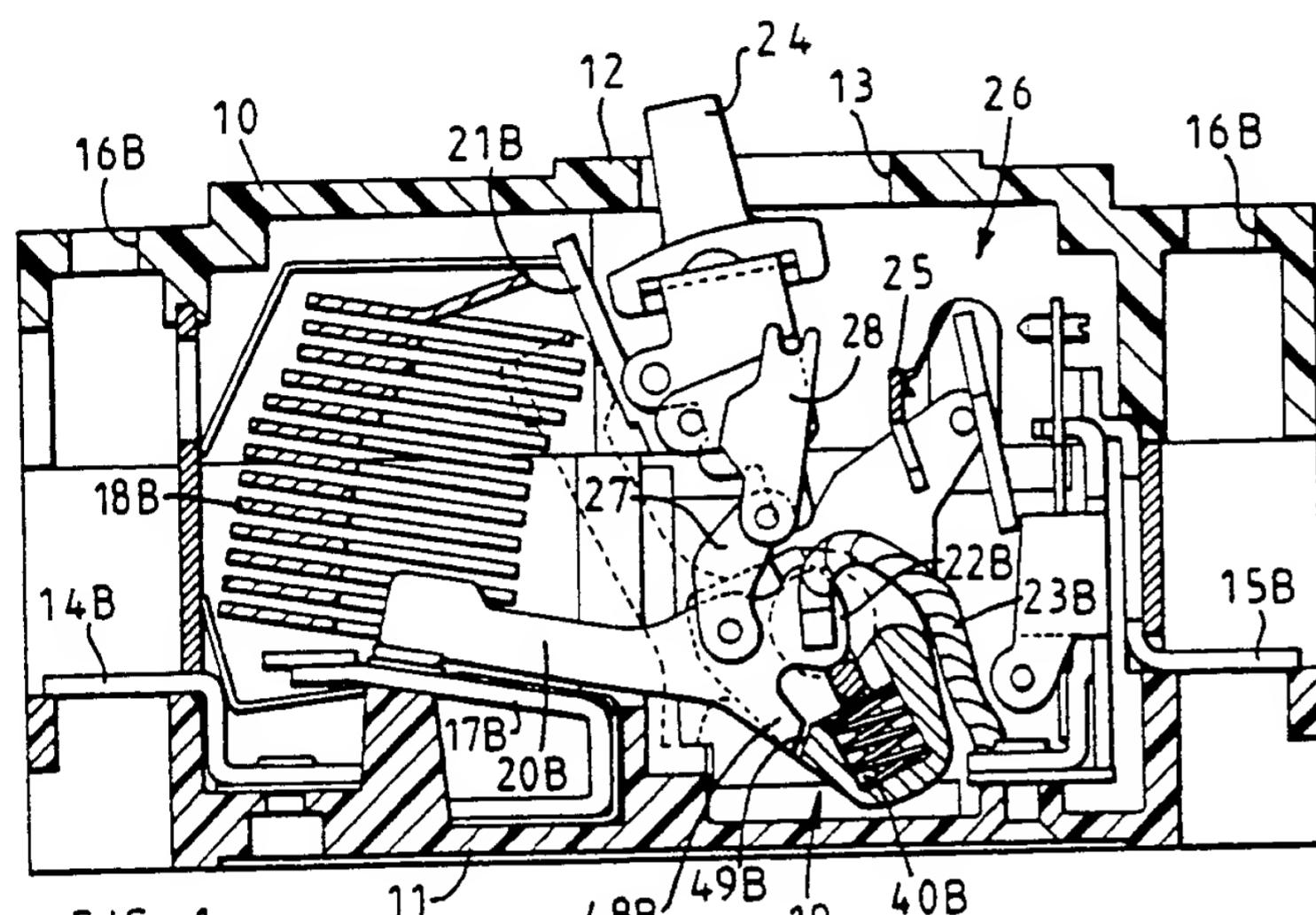


FIG 1

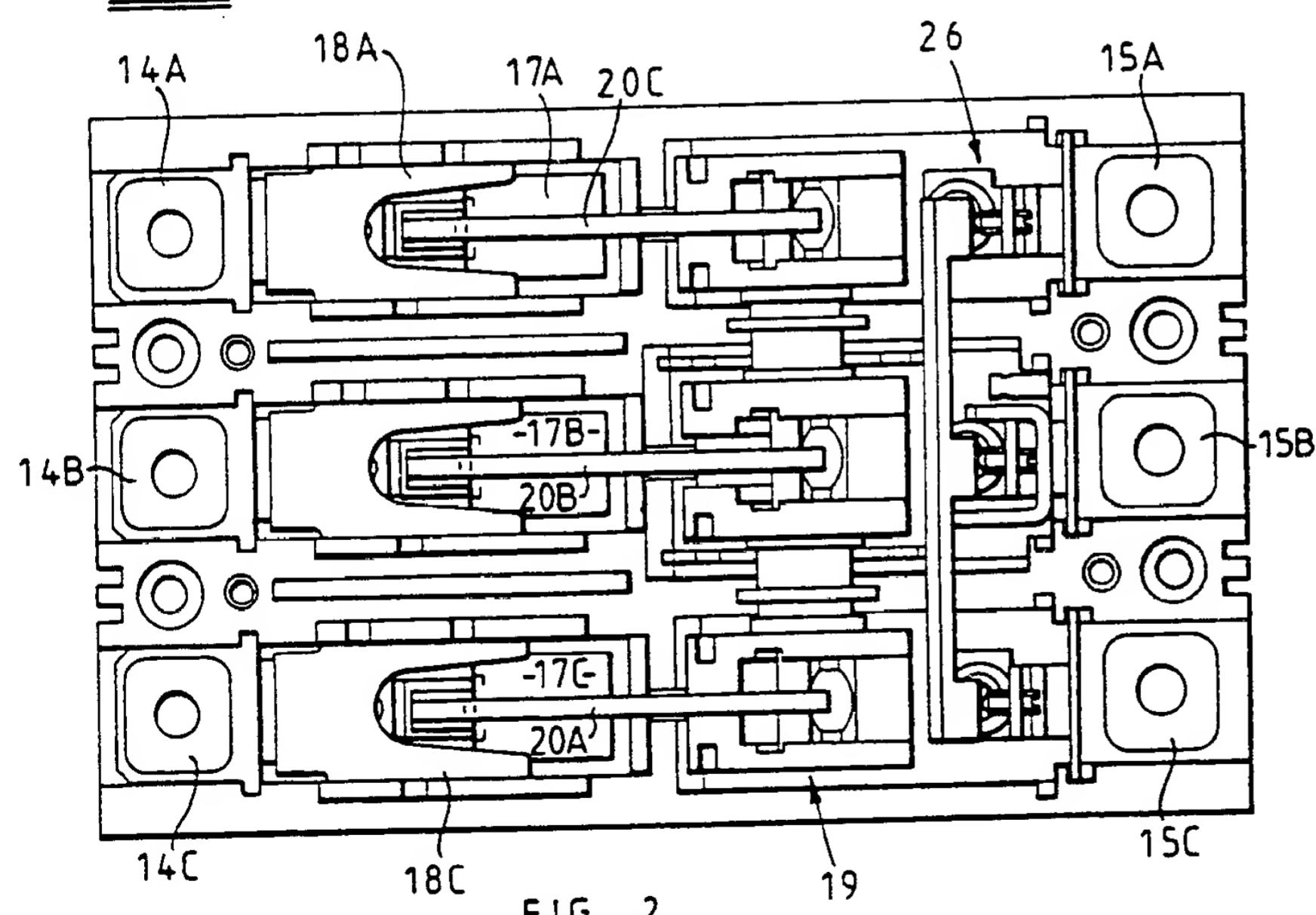


FIG 2

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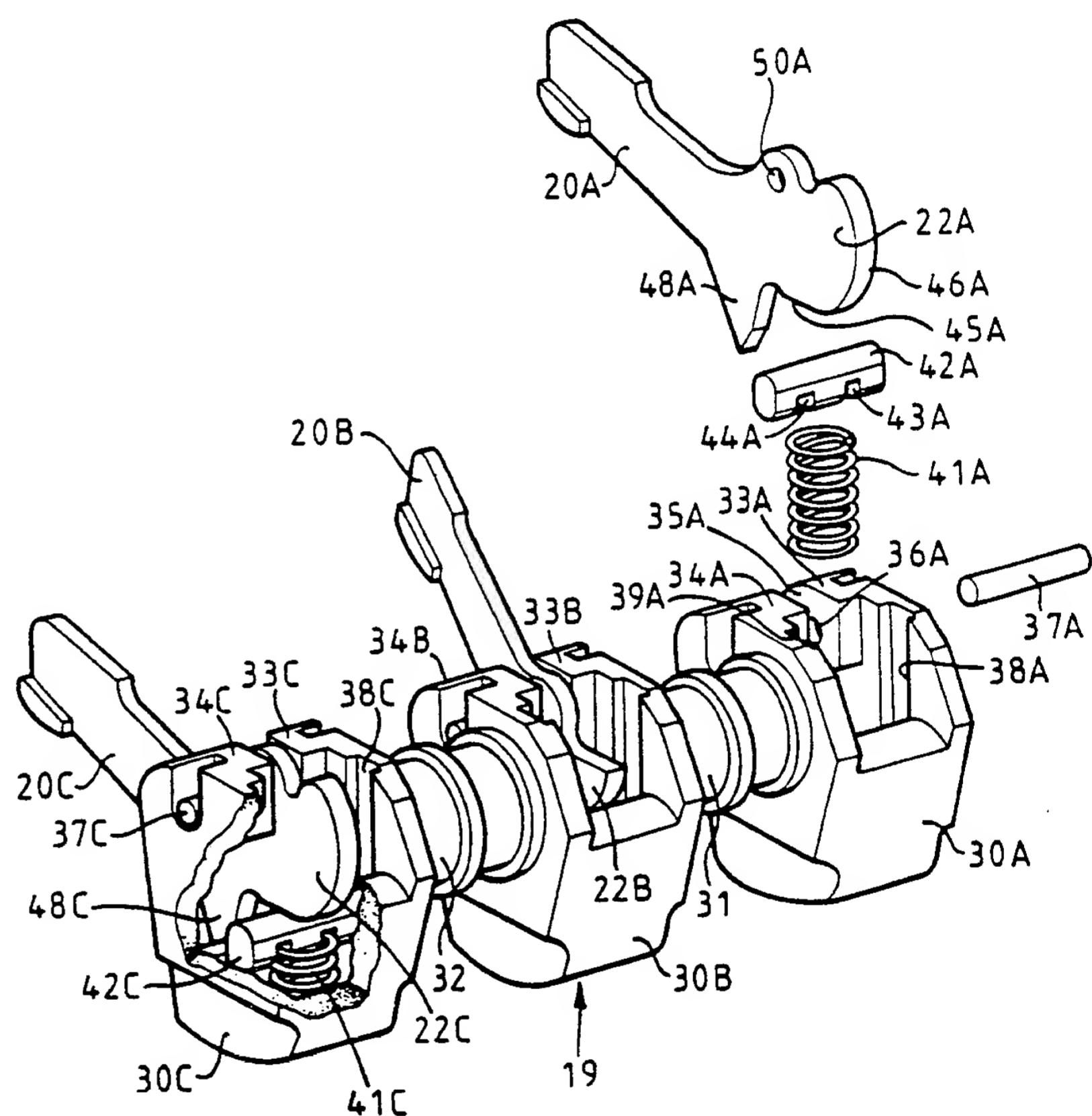


FIG 3

ELECTRIC CIRCUIT BREAKER

This invention relates to an electric circuit breaker.

In United Kingdom patent specification GB-A 1 564 412, there is described a circuit breaker which has a cross-bar, an operating mechanism for the cross-bar and pairs of movable and fixed contacts. Each movable contact is pivotally mounted on the cross-bar for movement between an operating position and a blown-back position, this movement occurring under the influence of electro-magnetic forces which are generating when a high fault current flows through the contacts. Each movable contact has an extension provided with an indent. The indent is engaged by a plunger which is loaded by a spring located in the recess in the cross-bar. As the movable contact arm moves between its operating and blown-back positions, the spring swings through a dead centre position with the result that the movable contact is biased into either its operating or its blown-back position. Because the recess in the cross-bar has to be large enough to accomodate the swinging movement of the spring, the cross-bar is bulky and this leads to a lack of compactness in the overall design of the circuit breaker.

It is an object of this invention to provide a new or improved circuit breaker in which the cross-bar has a compact design.

According to this invention there is provided an electric circuit breaker comprising a rotatably mounted cross-bar, at least one pair of first and second contacts, the or each contact being pivotally mounted on the cross-bar for movement between an operating

position and a blown-back position, and an operating mechanism for rotating the cross-bar between a closed position in which the first and second contacts of the or each pair of contacts normally engage each other and an open position in which the first and second contacts of the or each pair of contacts are separated from each other, there being provided, for the or each pair of contacts, a compression spring located in a recess in the cross-bar and an elongate cam follower guided in a pair of grooves formed in the cross-bar, said cam follower being urged by said spring into engagement with a cam surface formed on the first contact.

The arrangement of the spring, cam follower and cam surface enable the cross-bar to have a compact design.

This invention will now be described in more detail, by way of example, with reference to the drawings in which:

Figure 1 is a side sectional view of a circuit breaker embodying this invention;

Figure 2 is a plan of the circuit breaker of Figure 1 with the cover and part of the operating mechanism removed; and

Figure 3 is a perspective view of the cross-bar, partly in section and partly exploded so as to illustrate its operation and construction.

Referring to Figures 1 and 2, there is shown a three pole circuit breaker. In the following description, identical parts associated with the three different poles are denoted by identical reference

numerals but with the suffix letters A, B, C to distinguish between the different pole. The circuit breaker which has a cover 10 and base 11. The cover 10 and base 11 are molded in a plastics insulating material and together form the case for the circuit breaker. The cover 10 has a platform 12 provided with a central aperture 13. At each end of the base 11, there are provided three terminals 14A, 14B, 14C and 15A, 15B, 15C for connecting the circuit breaker to external cables. In use, the cables are held in place by clamps secured to the terminals by screws and the screw can be accessed through apertures, for example aperture 16B in the cover 10.

Each of the terminals 14A, 14B, 14C is connected to an associated fixed contact 17A, 17B, 17C located in an associated arc chamber. Each arc chamber is provided with a set of arc extinguishing plates, some which are indicated by references 18A, 18B, 18C.

The circuit breaker has a rotatably mounted cross-bar 19 which is formed from a plastics insulating material as a single piece moulding. Each of the fixed contacts 17A, 17B, 17C is associated with a movable contact 20A, 20B, 20C pivotally mounted on the cross-bar 19. Each movable contact 20A, 20B, 20C can move relative to the cross-bar 19 between an operating position, shown in solid lines in Figure 1, and a blown-back position, shown in dashed lines. In the event of a very high fault current through a pair of fixed and movable contacts, electro-magnetic forces arise which move the movable contact into the blown-back position, thereby breaking the circuit. In the blown-back position, each movable contact engages a stop plate, the stop plate for movable contact 20B being indicated by reference 21B in Figure 1.

Each of the movable contacts 20A, 20B, 20C has an extension 22A, 22B, 22C and each of these extensions is connected by a flexible cable to an associated one of terminals 15A, 15B, 15C. The cable connecting extension 22B to terminal 15B is indicated by reference 23B in Figure 1.

There is provided an operation mechanism for rotating the cross-bar 19 between a closed position in which the fixed and movable contacts engage each other and an open position in which the contacts are separated from each other. The operating mechanism is of a conventional construction and is partly shown in Figure 1. This mechanism will be described briefly.

The operating mechanism includes a handle 24. The upper part of handle 24 protrudes through aperture 13 formed in platform 12. The lower part of handle 24 is pivotally mounted on bearing surfaces formed in a pair of plates. The operating mechanism also includes a rotatably mounted cradle, not shown, and which is restrained against rotation by a latch plate 25. The latch plate 25 forms part of a trip mechanism 26. A toggle mechanism 27 and 28 is connected between the movable contact 20B and the cradle. The middle part of the toggle mechanism is connected by springs, not shown, to an upper part of handle 24 as viewed in Figure 1.

In operation, when the handle 24 is moved to the left, as shown in Figure 1, the springs cause the toggle mechanism to straighten, thereby rotating the cross-bar 19 in anti-clockwise direction, and causing the contacts 17A, 17B, 17C and 20A, 20B, 20C to close. When the handle 24 is moved to the right, these springs cause the toggle mechanism to collapse, thereby rotating the cross-bar in a clockwise direction and

opening the contacts.

In the event of a fault current, the trip mechanism 26 causes the latch plate 25 to release the cradle. The cradle then rotates, in well known manner, to a position where the springs cause the toggle mechanism to collapse, thereby rotating cross-bar 19 and opening the contacts. As mentioned above, in the event of a very high fault current, the contacts are blown apart and this occurs before operation of the trip mechanism 26.

The cross-bar 19 and associated part will now be described in greater detail with reference to Figures 1 and 3.

The cross-bar 19 has three enlarged portions 30A, 30B, 30C. The portions 30A and 30B are joined by a cylindrical portion 31 and the portions 30B and 30C are joined by a cylindrical portion 32. The portions 31 and 32 rest in bearing surfaces, not shown, which are formed in the base 11. Each of the portions 30A, 30B, 30C is identical and so the portion 30A will be described together with its connection to the movable contact 20A. However, certain parts are shown with reference to portion 30B and 30C and so the drawings for all three portions should be studied to gain a full understanding of the construction.

The portion 30A has a pair of side walls 33A, 34A which define a gap 35A for receiving the movable contact 20A. Apertures 36A are formed in walls 33A, 34A to receive a bearing pin 37A. When the movable contact 20A is assembled in portion 30A, the pin 37A passes through an aperture 50A of contact 20A thereby providing the pivotal connection between contact 20A and cross-bar 19.

Moving away from the gap 35A, the walls 33A, 34A open outwardly to form a generally open part of portion 30A. A pair of grooves 38A, 39A are formed in walls 33A, 34A. In the lower part of the portion 30A, the walls define a recess. The shape of the recess for the portion 30A cannot be seen clearly in Figure 3 but the shape of the recess 40B for enlarged portion 30B can be seen clearly in Figure 1.

When the movable contact 20A is assembled on cross-bar 19, a compression spring 41 is located in the recess. An elongate cam follower having a generally oval cross-section is guided by grooves 38A, 39A, and located between the compression spring 41A and the extension 22A of contact 20A. The cam follower 42A has a pair of slots 43A, 44A for engaging the spring 41A.

The extension 22A has a cam surface having a first straight portion 45A and a second curved portion 46A. The portion 46A is of spiral shape so that its radius of curvature decreases in the direction away from this surface 45A.

The movable contact 20A has a lobe 48A which is capable of engaging an exterior surface on portion 30A. In Figure 1, the relationship between the lobe 48B and exterior surface 49B can be readily appreciated.

In operation, under normal circumstances, the spring 41A biases the cam follower 42A into engagement with cam portion 45A. When the cross-bar 19 is rotated to its closed position, this results in the movable contact 20A engaging the fixed contact 17A with a biasing force determined by spring 41A.

During the initial rotation of the cross-bar 19 from its closed position towards its open position, the

spring 41A causes the cam follower 42A to rotate the movable contact 20A through a small angle until the lobe 48A engages the exterior surface. After this has occurred, the movable contact 20A moves in unison with the cross-bar 19.

In the event of a high fault current flowing through contacts 17A and 20A, the movable contact 20A is urged away from the contact 17A under the influence of the electromagnetic forces which arise. During the initial part of this movement, the cam follower 42A engages the cam portion 45A, thereby applying a biasing force on contact 20A in opposition to the electromagnetic forces. After initial rotation of contact 20A, the cam follower 42 will engage the initial part of the cam portion 46A. When this happens, the movable contact 20A will no longer be biased towards the contacts 17A by spring 41A. Indeed, because the cam portion 46A has a spiral shape the spring 41A causes the cam follower 42A to apply a biasing force to contact 20A which is in the same direction as the electro mechanical forces and so the contact 20A will rotate clockwise until it engages its associated stop plate.

In the event of a high but not excessive fault current, the spring 41A will prevent the contact 20A from being blown-back. By appropriate selection of the characteristics of spring 41A and the contour of cam portions 45A and 46A, the fault current at which blow-back occurs can be set as desired.

CLAIMS:

1. An electric circuit breaker comprising a rotatably mounted cross-bar, at least one pair of first and second contacts, the or each first contact being pivotally mounted on the cross-bar for movement between an operating position and a blown-back position, and an operating mechanism for rotating the cross-bar between a closed position in which the first and second contacts of the or each pair of contacts normally engage each other and an open position in which the first and second contacts of the or each pair of contacts are separated from each other, there being provided, for the or each pair of contacts, a compression spring located in a recess in the cross-bar and an elongate cam follower guided in a pair of grooves formed in the cross-bar, said cam follower being urged by said spring into engagement with a cam surface formed on the first contact.
2. A circuit breaker as claimed in claim 1, wherein said cam surface comprises a first portion which engages the cam follower when the first contact is in its operating position and a second portion which is curved and engages the cam follower when the first contact is blown-back.
3. A circuit breaker as claimed in claim 2, wherein said second portion of the cam surface has a spiral shape so that the first contact is biased into the blown-back position.

4. A circuit breaker as claimed in any one of the preceding claims, wherein the or each first contact has a lobe for engaging an external surface on the cross-bar so as to ensure that the first contact moves with the cross-bar during movement thereof from said closed position to said open position.
5. A circuit breaker substantially as hereinbefore described with reference to the accompanying drawings.